



Aalborg Universitet

AALBORG UNIVERSITY  
DENMARK

## Mathematical modelling of MSW incineration in a packed bed

Chen, Guanyi; Gu, Tianbao; He, Xiao; Yin, Chungen; Ma, Wenchao; Yan, Beibei; Hou, Lian

*Published in:*

Proceedings of the 1st International Symposium on BioEnergy and Environment (BEE2017)

*Publication date:*  
2017

*Document Version*  
Publisher's PDF, also known as Version of record

[Link to publication from Aalborg University](#)

*Citation for published version (APA):*

Chen, G., Gu, T., He, X., Yin, C., Ma, W., Yan, B., & Hou, L. (2017). Mathematical modelling of MSW incineration in a packed bed. In *Proceedings of the 1st International Symposium on BioEnergy and Environment (BEE2017)* Tianjin University Press.

### General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal -

### Take down policy

If you believe that this document breaches copyright please contact us at [vbn@aub.aau.dk](mailto:vbn@aub.aau.dk) providing details, and we will remove access to the work immediately and investigate your claim.

## Mathematical modelling of MSW incineration in a packed bed

Guanyi Chen<sup>1,2</sup>, Tianbao Gu<sup>1</sup>, Xiao He<sup>1</sup>, Chungun Yin<sup>3,\*</sup>, Wenchao Ma<sup>1,\*</sup>, Beibei Yan<sup>1</sup>, Li'an Hou<sup>1,4</sup>

<sup>1</sup>*School of Environmental Science and Engineering/State Key Lab of Engines, Tianjin University, Tianjin 300072, China*

*E-mail: mawc916@tju.edu.cn*

<sup>2</sup>*School of Science, Tibet University, Lhasa 850012, Tibet Autonomous Region, China*

<sup>3</sup>*Institute of Energy Technology, Aalborg University, DK-9220 Aalborg East, Denmark*

*E-mail: chy@et.aau.dk*

<sup>4</sup>*The Second Artillery Engineering University, Xi'an 710025, PR China*

**Abstract:** Grate-firing is the most commonly used technology for municipal solid waste (MSW) incineration for heat and power generation, in which MSW undergoes thermochemical conversion (e.g., drying, devolatilization, char gasification and oxidation) in the fuel bed on the grate while the combustible gases and the entrained fine particles are further burned in the freeboard. Nevertheless, grate-firing generally needs to be improved in terms of efficiency and overall environmental impacts, in which computational fluid dynamics (CFD) modelling plays the vital role. In this paper, a comprehensive mathematical model is developed to simulate MSW incineration in a packed bed which is subject to the heating source on the bed top and the primary air flow at the bed bottom. The entire fuel bed is discretized into a number of control volumes. In each of the control volumes, the transport equations for mass, momentum, energy and individual species, which fully address the MSW thermochemical conversion (including trace elements), as well as heat and mass transfer are numerically solved by using the finite volume method(FVM). The model is verified by comparing the predictions against the experimental results of MSW incineration in a packed bed under given condition available in the literature. After appropriate extension, the model will be used for MSW incineration in the fuel bed in a real MSW-fired grate boiler, aiding CFD-based design and operation optimization for the boiler.

**Keywords:** MSW incineration, CFD, thermochemical conversion, FVM